MACHINING METHOD OF A LAST FOR MAKING SHOES AND MACHINING CENTRE BY NUMERICAL CONTROL TO CARRY OUT THIS METHOD

The present invention refers to a machining method of a last for making shoes and to a machining centre by numerical control to carry out this method.

BACKGROUND OF THE INVENTION

One of the most important processes in the production of shoes is the design and production of moulds. In this process it is necessary to distinguish among the designed for the production of the shoe sole and those that finally will give form to the skin or other utilized materials to give the final aspect to the finished product.

For this last purpose moulds known as lasts are used, that imitate the form of the foot and are placed inside the shoe during its conformation process.

The form of the last will depend on the shoe type or model, or on the different sizes. For this reason, the quantity of lasts that should be made can become considerable, especially in launching campaigns of new ranges of products.

The production process of the lasts begins with the design of them with computer assisted design tools and then programming a numerical control machine. This machine takes charge to begin the machining of a piece, usually of polyethylene, by means of the rough-hewn of its surface. The rough-hewn consists on fixing the piece by two points, making it rotate about the axis defined by these two fixing points, and, by means of rough-hewn blades, machining the surface of the piece to give it the desired form to the last.

In this process the two reference or fastening

points are also marked in the toe and in the heel-pad of the last, which will serve to fix it later on in other steps of the process.

Once it is finished the first rough-hewn process, the lasts pass to another machine for a more precise finishing, with smaller blades with the capacity to polish and to improve the surfaces of the last. In this process, the finishing machine fastens the lasts by the same points, heel-pad and toe, respecting the reference points marked initially by the first rough-hewn machine.

In this point, a last is obtained with the polished surfaces and the definitive curves, except in the toe and the heel-pad, points where the machine fastens the lasts and the blades cannot act, so that there are a pair of surpluses that protrude between two and three centimeters according to the size or number.

The following steps to obtain the definitive shape, as finished product for the use in the production of shoes, are manual tasks or they need directly the manpower to operate other tools.

In the first place, to eliminate the surpluses that protrude in the toe and in the heel-pad of the last, it is cut hand-operated with the help of a saw, polishing the surface later on to eliminate remains.

It is also necessary to make an oblique cut that separates the part of the instep of the last, since once this is used to stretch the skin of the shoe, it would not be possible its extraction if it is not taken out before the part of the instep. This piece is fixed threading a spike that presses it and that it does not allow its extraction until it is not unthreaded.

To be able to thread the spike, and to mount a fastening ferrule which will serve to fasten the last in later steps, there are carried out a couple of holes of different diameter in the upside of it. This operation

also requires de the action of an operator.

In a following step, the last is identified labeling by hand the foot size number (left and right) marked with a marker and the reference of the model.

As last step, it is carried out the flaming of the lasts, with the objective of eliminate the filings which could left on it.

As it can be observed, the last steps that must be done to obtain an excellent finishing of the lasts, at the moment need the direct manpower to be carried out.

Until the present time, they have not still been possible to automate these last steps of the manufacturing process of the lasts, so that the time consumption that supposes to have to carry out manually all these operations is considerable.

Machines exist for the manufacturing of physical prototypes of lasts that, although they eliminate the surpluses of the toe and the heel-pad, they cannot be used in production processes, due to their high maneuver times.

There also exists another type of machine for the removal of the surplus of the toe by means of polishing, which are feasible for the industrial production. However, their fastening system, by means of pressure, it is not valid for some last designs.

DESCRIPTION OF THE INVENTION

The object of the present invention is to provide a method that substantially simplifies and speeds up the finishing process in the last production.

To this effect, a first aspect of the invention proposes a machining method of a last for the production of shoes, which comprises these operations: rough-hewn, piercing, identification marking, and removal of the resulting surpluses of the rogh-hewn operation, which it

is characterized in that it comprises the following steps:

a) Manual positioning de the last in a machining center by numerical control, fixing it by fitting the housings present in the surpluses located in the heel-pad and in the toe of the last and first movable fastening means in the machining center;

b) Piercing and identification marking of the last by means of a drill in the machining center, the last being fastened and positioned by said first movable fixing means;

c) Manual extraction of the last of the first movable fixing means and manual fastening of it to second movable fastening means in the machining center, which introduce inside holes made previously in the last in the step of piercing and identification marking;

d) Removal by automated machining, by means of the drill, of the surpluses which remain free.

Thanks to these characteristics, the finishing process in the production of the last it is carried out practically in its entirety in an automated way. The method comprises the removal of the surpluses, the piercing of the last, and its marking. Therefore, they are carried out three operations in the same method and in the same machine.

Preferably, the piercing operation of the last comprises the machining of a plurality of holes in the sole of the last, a hole in the shoulder of the instep, and other two holes of different diameter in its upside.

The three holes of the sole will allow the later placement of the insole, and the two holes of the upside will serve to hold the last and to introduce a fastening spike of a part of the last that will be cut.

Advantageously, the positioning operation of the last for its piercing and its identification marking is carried out rotating the last by means of the first

movable fastening means.

This way, the drill will be able to access easily to the whole surface of the last.

Also advantageously, the removal process of the surpluses is carried out fixing the last by the two holes of different diameter practiced in its upside to the second movable fastening means.

This way, the surpluses are liberated of the first fastening means and they can be eliminated by means of a simple change of position of the last.

In this case, preferably, the positioning of the last in the removal step of the surpluses is carried out rotating it by means of the second movable fastening means.

As in the previous step, the drill can access easily to the two surpluses.

According to an embodiment of the method, the first movable fastening means fix the last in an horizontal position and the second movable fastening means fix the last in a vertical position.

Advantageously, the turn of the last by the first movable fastening means and by the second movable fastening means is carried out about an horizontal axis.

This way, it is not necessary to prepare more than a drill to mechanize the last in the different steps.

In another aspect, the invention provides a mechanization center by numerical control for the piercing, identification marking, and removal of the resulting surpluses of a previous rough-hewn process, of a last for the production of shoes, which is characterized in that it comprises a plurality of drills, first movable fastening means for its fitting in housings present in the surpluses located in the heel-pad and in the toe of the last, and second movable fastening means for its introduction inside holes made in the last by a drill.

In an embodiment of the machining center, the first movable fastening means comprise a first support for its fitting in the housing of the surplus of the heel-pad of the last, and a second support for its housing for its fitting in the housing of the surplus of the toe of the last, being both variable supports in angle and being able the first support (11b) to rotate about its own axis.

According to another embodiment, the second support (11a) can rotate about its own axis.

Preferably, the second support is fixed to height and depth regulation means for the correct fastening of different sizes and types of the lasts.

Thanks to these characteristics, the last can be suitably positioned independently of its form or size before being machined.

Advantageously, the height regulation means comprise an endless screw which can be driven by means of a rotating handle, and the depth regulation means comprise a pneumatic piston which can be driven by means of a manual control.

This way, it is facilitated to the maximum the placement process of the last in the machining center.

Also advantageously, the supports includes a couple of complementary protrusions to the housings of the surpluses of the last.

This way, the subjection of the last is safe and solid, avoiding that it moves with regard to the fastening means during the machining.

Preferably, the second movable fastening means comprise an arm, with ability of rotate about an axis that includes two cylinders of different diameter, including the cylinder of greater diameter pressure means against the walls of the hole of the last in which is housed.

In this case, advantageously, the pressure means comprise a hollow shaft whose external walls present a

section change that houses inside it a piston of a pneumatic cylinder, being connected this piston at its end to a head provided with a skirt that includes flexible wings, so that when the piston goes back it forces the head to move on the external walls of the axis, so when it arrives to the section change the fins expand against the walls of the hole of the last.

Therefore, the last is compactly fixed during the removal of the surpluses, allowing the maximum operation precision.

Advantageously, the drills are interchangeable.

This way, with a single drillholder different drills can be used according to the operation of machining to be carried out.

BRIEF DESCRIPTION OF THE DRAWINGS

With the purpose of facilitating the description of what has been described previously some drawings are attached which, schematically and only by way of a non-limitative example, a practical case of embodiment of the method and the machining center of the present invention is represented, in which:

figure 1 is a representation of the last before being machined;

figure 2 is a representation of the last after being machined;

figure 3 is a view of the machining center and the last in the first machining phase;

figure 4 is a detailed view of the first fastening means of the machining center;

figure 5 is a detailed view of an alternative embodiment of the first fastening means of the machining center;

figure 6 is a detailed view of the second

fastening means of the machining center;

figure 7 is a view of the machining center and the last in the second machining phase;

figures 8 and 9 are schematic representations that show the operation of the second fastening means of the machining center.

DESCRIPTION OF PREFERRED EMBODIMENT

In figure 1, it may be seen the last 1 as it leaves of the rough-hewn process. In this process, the surface of the last 1 is machined making rotate a piece of polyethylene about an axis defined by two supports. These supports hold the last housed in a pair of housings 2, 3 located in the toe and in the heel-pad, respectively. Therefore, in the area in which there are these housings left surpluses 4, 5 not machined which must be eliminated.

Figure 2 shows how the last 1 will be after passing by the method of the present invention.

As may be seen, the last 1 already presents its definitive shape, the surpluses 4, 5 have been eliminated, there are made a couple of holes 6a, 6b in the upper area, a hole 6c which crosses horizontally the instep, and other three holes 6d in the area of the sole. On the other hand, it is also recorded the number of size 7 of the last 1 and other data on it.

The hole 6b made in the upside of the last 1 has the function to house a spike that will hold a part of the instep 8 that will be cut, in a later phase, to facilitate the extraction of the footwear.

The hole 6a will serve like fastening means of the last 1 in later production phases, and also, as will be described later on, it will serve to hold the last 1 in the process of the invention.

The hole 6c is designed to facilitate the

extraction of the instep 8 when the last is housed in the footwear.

The holes 6d of the sole of the last 1 will be used later on to insert some metallic head screws without exit that will allow the introduction of a head that will pierce a plastic insole that will fix it quickly and precisely to the sole of the last 1. This way, it is obtained a new improvement in the whole chained process of production of the footwear.

Hereinafter, it will be described the process that will be carried out for machining the last 1 detailedly.

As it can be seen in figure 3, the last is placed in a machining center 10 as it is shown. The center 10 is provided with first fastening means that consist on supports 11a, 11b that hold the last 1 by the housings 2, 3 present in the surpluses 4, 5 present in the toe and in the heel-pad, respectively. As it has been explained previously, these housings 2, 3 had already been used in a previous rough-hewn process, so that it is not necessary to machine them expressly for this process. In figure 4 it can be seen a detail of the supports 11a, 11b, which present protrusions 12 that will be housed in the respective housings 2, 3. This way, the fastening of the last 1 is carried out of consistent form and it permits the rotation without problems.

In another embodiment, shown in figure 5, the support 11a presents a single cylindrical protrusion 12 that will be housed in a complementary housing 2 present in the surplus 4 of the toe of the last 1, so that the turn of it takes place without necessity of rotation of the support 11a too. Although the protrusion 12 of this embodiment is cylindrical, its shape could also be conical or similar, so it allows the rotation of the last without any difficulty.

The placement of the last 1 in the machining center 10 is carried out by an operator that will regulate the position of the supports 11a, 11b according to the measure and characteristics of the last 1, in order to position it correctly.

For this, these supports 11a, 11b have means which permits the vary their position. Both supports 11a, 11b can vary in angle, and can rotate about their own axis. The support 11a, also, is fixed to means that allow the height and in-depth regulation of it. These means consist on a pneumatic piston 13 that will regulate the depth, and on a endless screw 14 that by means of its turn, moves in height the support 11a. The piston 13 and the endless screw 14 are commanded respectively by an operator by means of a joystick and a rotatable handle (not shown).

This way, the operator can position the last 1 quickly and effectively.

Once the last 1 is correctly positioned, the machining process begins. A drill 15 takes charge to machine the last, making the holes shown in figure 2. To access to the different points on the surface of the last 1, the center 10 carries out the necessary movements: the support 11b which is associated to the fourth axis of the machining center 10 makes rotate the last 1 thanks to the action of a motor 9, a movable bank 16 makes the horizontal displacement of it which holds all the fastening devices of the last 1, and the drill 15 makes the vertical movement.

This way, the drill 15 can access to the whole surface of the last 1 and make the holes without difficulty. To machine holes of different diameter or to carry out the identification marking of the last, the center 10 has additional drills 17 of different size and characteristics, using the most convenient in each case.

Once concluded this phase, the last 1 already have all the necessary holes and the identification marking (see figure 2).

In the following phase, the surpluses 4,5 of the last 1 are eliminated.

For this, an operator removes the last of the supports 11a, 11b to fix it in second fastening means located in an arm 18 with can turn about an horizontal axis which is, as the first support 11b of the first fastening means, associated to the fourth axis of the center 10, as figure 6 shows.

These second fastening means (see figure 5) are constituted by a couple of cylinders 19, 20 of different size. The fastening is carried out introducing these cylinders 19, 20 in the holes 6b, 6a made in the previous phase, so that the last 1 is in a vertical position.

To retain efectively the last, the cylinder 20 is provided with pressure means against the internal walls of the hole 6a of the last 1, once it has been introduced in it.

The operation of these means is described in figures 7 and 8.

At the moment in which the last 1 is placed in the second fastening means, the cylinders 19 and 20 are introduced respectively in the holes 6b and 6a.

The cylinder 20 is formed by a hollow shaft 21 whose external walls present a widening 22. This axis 21 house in its interior a piston 23 associated to a pneumatic cylinder 24, and coupled at its end to a head 25 provided with a skirt formed by flexible wings 26.

Once the last 1 have been placed, the pneumatic cylinder 24 is driven, displacing the piston 23 that in turn drags the head 25. When the head 25 arrives to the widening 22, the wings 26 expand and they press against the internal walls of the hole 6a of the last 1.

The removal of the surpluses 4, 5 is carried out similarly to the first phase, by means of the combined action of the arm 18 driven by the motor 9 (rotation movement), the movable bank 16 (horizontal movement) and the drill 15 (vertical movement).

Once eliminated the surpluses 4, 5 the last 1 already present their practically definitive form, with all the necessary holes for later phases gives the carried out production, properly marked and identified, and without surpluses.

As it may be seen, the method and the machining center of the invention present some advantages in front of the current production systems of lasts, among the most significant, it is necessary to highlight:

- Shorter control control and calibration times, thanks to the great precision of the machining and to the faithful reproduction according to the designs.

- Reduced waiting times between machines, thanks to the possibility to carry out on one machine more operations, and therefore, a greater use of the surface of the factory.

- Reduction of the number of verifications between operations.

- Increase of the production flexibility in terms of easy adaptability to the embodiment of different types which are manufactured.

- Decrease of the rejection of fabricated shapes, as consequence of the greater precision of the machine.

- It is eliminated the necessity to use a great quantity of tools, with the consequent saving.

- Possibility to carry out more economicaly pieces of complicated geometry.

- It improves of the onsite work security, when decreasing the interactivity degree between the machine

and the operator during the machining process.

- Smaller number of operators to use the machine.

Hereinafter, a comparative table is shown in which the time has been calculated for the production of a couple of lasts as there are carried out now and by means of the method object of the invention.

Current method:

Operation	Time
Rough-hewn of the lasts with irregular finishing	1'30"
Finishing of the lasts	6'55"
Marking, piercing of the last and insertion of the metallic case	45'
Cutting and polishing of the surpluses of the heel-pad	9'20"

Operation	Time
Cutting the instep and spike threading	3'
Flaming	20"
TOTAL TIME	21'50"

New method:

Operation	Time

Rough-hewn of the lasts with irregular finishing	1'30"
Finishing of the lasts	6'55"
Piercing, marking of the lasts and rough-hewn of the surpluses of the toe and the heel-pad	2'
Cutting the instep, threading the spike to hold the instep, Insertion of the metallic case	3'
Flaming	20"
TOTAL TIME	13'45"

The time difference between methods both it is of more than eight minutes for each couple of lasts. So, it can be deduced that in industrial production the productivity increase with the method of the invention it is very significant.